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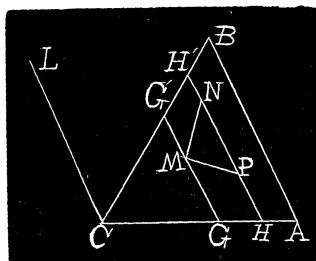
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$$\begin{aligned}
&= \frac{6 \sin A}{b^2 c^2} \int_a^b \int_0^{x'} \int_0^x \left\{ \int_0^u \int_0^{x'} (x-y)(u-v) dv dz \right. \\
&\quad \left. + \int_0^b \int_0^{x'} (x-y)(v-u) dv dz \right\} du dx dy \\
&= \frac{6 \sin A}{b^3 c^2} \int_a^b \int_0^{x'} \int_0^x \left\{ \int_0^u (x-y)(uv-v^2) dv \right. \\
&\quad \left. + \int_0^b (x-y)(v^2-uv) dv \right\} du dx dy \\
&= \frac{\sin A}{b^3 c^2} \int_a^b \int_0^{x'} \int_0^x (2u^3 + 2b^3 - 3b^2 u)(x-y) du dx dy \\
&= \frac{\sin A}{2b^3 c^2} \int_a^b \int_0^{x'} (2u^3 + 2b^3 - 3b^2 u) x^2 du dx \\
&= \frac{c \sin A}{6b^6} \int_0^b (2u^6 + 2b^3 u^3 - 3b^2 u^4) du \\
&= \frac{13bc \sin A}{420} = \frac{13}{210} \frac{1}{2} (bc \sin A) = \frac{13}{210} (\text{area of given triangle})
\end{aligned}$$



9. Proposed by H. C. WHITAKER, B. S., M. E., Professor of Mathematics, Manual Training School, Philadelphia, Pennsylvania.

Four numbers taken at random are multiplied together. What is the probability that the last digit will be 0?

- I. Solution by H. W. DRAUGHON, Clinton, Louisiana.

The probability that the final digit will be odd is  $(\frac{1}{10})^4 = \frac{1}{10000}$ ; the probability that it will be 2, 4, 6, or 8, is  $(\frac{4}{10})^4 + 4(\frac{4}{10})(\frac{1}{10})^3 + 6(\frac{4}{10})^2(\frac{1}{10})^2 + 4(\frac{4}{10})^3(\frac{1}{10}) = \frac{15(4)^4}{10000} = \frac{3840}{10000}$ .  $\therefore$  the probability that it will be 0 is,  $P = 1 - \frac{3840}{10000} - \frac{1}{10000} = \frac{5569}{10000} = \frac{11137}{20000}$ .

- II. Solution by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics and Astronomy in New Windsor College, New Windsor, Maryland.

We know from *Hall and Knight's Higher Algebra* if  $n$  integers be taken at random and multiplied together, the probability that the last digit of the product is 1, 3, 7, or 9, is  $P_1 = \frac{4^n}{10^n}$ ; also, the probability that the last digit of the product is 2, 4, 6, or 8, is  $P_2 = \frac{8^n - 4^n}{10^n}$ ; and, finally, the probability that the last digit of this product is 5, is  $P_3 = \frac{5^n - 4^n}{10^n}$ . Consequently the probability that the last digit of this product is zero, when  $n=4$ , is  $P_4 = 1 - (P_1 + P_2 + P_3)$ ; that is,  $P_4 = \frac{10^4 - 8^4 - 5^4 + 4^4}{10^4} = \frac{(5^4 - 4^4)(2^4 - 1)}{5^4 \times 2^4} = \frac{1107}{2000}$ .

Solutions to this problem were also received from Hon. JOSIAH DRUMMOND, P. H. PHILBRICK and J. F. W. SCHEFFER.

## PROBLEMS.

18. Proposed by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics and Astronomy in New Windsor College, New Windsor, Maryland.

A surface one inch square is thrown at random upon a surface one foot square, but so as always to lie wholly upon the larger surface. Find the mean value of the *sum of the distances* of the vertices of the smaller surface, from *any* vertex of the larger surface.

19. Proposed by H. W. DRAUGHON, Clinton, Louisiana.

From one corner of a square field, a boy runs in a random direction, with a random uniform velocity. The greatest distance the boy can run in one minute is equal to the diagonal of the field. What is the probability that the boy will be in the field at the end of one minute?

Solutions to these problems should be received on or before December 1st.

## MISCELLANEOUS.

Conducted by J. M. OOLAW, Monterey, Va. All contributions to this department should be sent to him.

## SOLUTIONS TO PROBLEMS.

4. Proposed by J. K. ELLWOOD, A. M., Principal of Colfax School, Pittsburg, Pennsylvania.

I have two grindstones, each  $\frac{1}{2}$  inch thick. One is 6 in. and the other  $4\frac{1}{2}$  in. in diameter, the aperture at center of each being  $1\frac{1}{4}$  in. If when in motion the yare continually tangent to each other, and  $\frac{1}{4}$  cu. in. is ground off the larger wheel and  $\frac{1}{4}$  cu. in. off the smaller in the first hour, how must their speed be increased so that the same amount per hour may be ground off each wheel until one is worn out? If in the first hour the larger wheel makes  $a$  revolutions, and the smaller  $b$ , how many must each make in each succeeding hour?

II. Solution by P. H. PHILBRIK, O. E., Lake Charles, Louisiana.

The diagonal of the aperture is,  $\sqrt{45}=2.1213$ . Vol. of larger stone outside of the circle circumscribing the aperture is,  $\frac{1}{2}\frac{\pi}{4}(36-4.5)=12.37$  and the same for the smaller stone is,  $\frac{1}{2}\frac{\pi}{4}(20.25-4.5)=6.185$ . The stones will therefore wear out at the same time and in  $12.37 \div \frac{1}{2}=24.74$  hours.

The side face of larger stone including the aperture  $=\frac{\pi}{4}36=28.27$ ;

and the available area  $=\frac{\pi}{4}(36-4.5)=24.74$ . One inch area is therefore worn off the side face of the larger stone per hour and one half of an inch off the face of the smaller stone. Hence, including the aperture, the side face of the larger stone at the end of the first hour is 27.27.

At end of second hour 26.27.

At end of third hour 25.25.

etc., etc.

At the end of the  $24\frac{1}{2}$  hour is 4.27.